CLAIM OR CLAIMS

WHAT IS CLAIMED IS:

1. A method of deriving a step function response for a transmission channel having a band limited frequency response comprising the steps of:

deriving a distance-to-fault (DTF) signal from the band limited frequency response;

estimating an impulse response function as a function of the DTF signal and a window function; and

accumulating the impulse response function to produce the step response function.

2. The method as recited in claim 1 wherein the deriving step comprises the steps of:

downshifting the frequency band of the band limited frequency response to baseband to produce a baseband signal;

performing an inverse Fourier transform on the baseband signal to produce a time domain signal;

upconverting the time domain signal to produce a complex time domain signal; and

extracting the DTF signal from the complex time domain signal.

3. The method as recited in claim 1 wherein the deriving step comprises the steps of:

processing the band limited frequency response to produce a complex time domain signal according to the function

$$h(n) = 1/N\sum_{k=0\text{-}(N-1)}H(\omega_k)e^{j2\pi(k/2N)n} = \mathrm{IDFT}(2H,2N)$$

where h(n) is the complex time domain signal and $H(\omega_k)$ is a reflection coefficient at frequency ω_k (k = 0,1,...,N-1); and

extracting a real portion of the complex time domain signal as the DTF signal.

4. The method as recited in claim 1 wherein the estimating step includes the steps of:

identifying reflection events from the DTF signal; and

performing the estimating step for data points from the DTF signal localized about each reflection event.

5. The method as recited in claim 4 wherein the identifying step comprises the step of user interactively defining the data points localized about each reflection event observed in the DTF signal.

6. The method as recited in claim 4 wherein the identifying step comprises the steps of:

determining a detection function for the DTF signal; and

locating data points localized about the reflection events when the detection function exceeds a predetermined threshold.

7. The method as recited in claims 4, 5 or 6 wherein the performing step comprises the step of applying least-square error criteria.

8. The method as recited in claims 1, 2 or 3 wherein the estimating step comprises the step of processing the DTF signal to obtain the impulse response according to the function

$$h_{DTF}(n) = I(n) - I(n) \otimes w(n)$$

where $h_{DTF}(n)$ is the DTF signal, $I(n)$ is the impulse response and $w(n)$ is the window function

$$w(n) = \sin(\omega_0 n/F_s)/\pi n$$

where ω_0 represents a starting frequency of the band limited frequency response and F_s represents a sampling frequency.

9. The method as recited in claim 8 wherein the estimating step further comprises the steps of:

identifying reflection events in the DTF signal; and

performing the DTF signal processing step for data points localized about each reflection event.

10. The method as recited in claim 9 wherein the identifying step comprises the step of user interactively defining the data points localized about each reflection event observed in the DTF signal.

11. The method as recited in claim 10 wherein the performing step comprises the step of applying least-square error criteria.

12. The method as recited in claim 9 wherein the identifying step comprises the steps of:

determining a detection function for the DTF signal; and

locating data points localized about the reflection events when the detection function exceeds a predetermined threshold.

13. The method as recited in claim 12 wherein the performing step comprises the step of applying least-square error criteria.

14. The method as recited in claims 1, 2, 3 or 4 further comprising the step of displaying the impulse response and step function response.

15. The method as recited in claim 7 further comprising the step of displaying the impulse response and step function response.